BPA's Energy2020/PowerWorld Analysis Update

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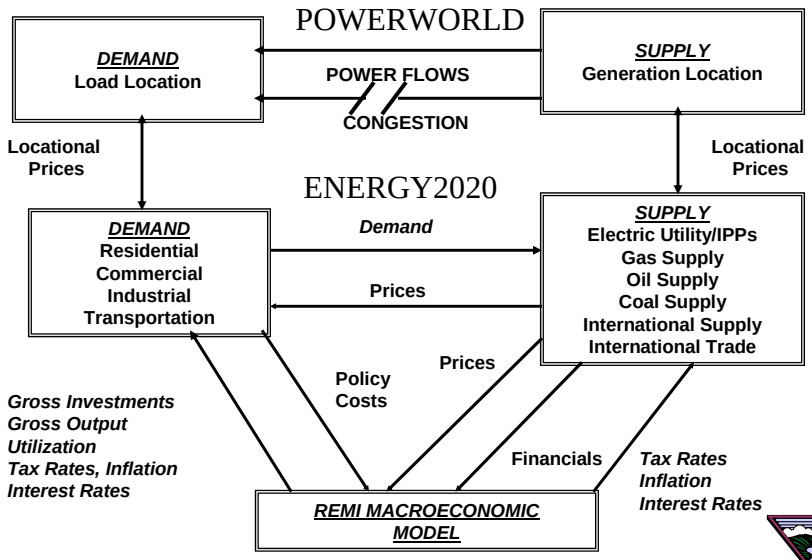
Energy Efficiency

Energy2020/PowerWorld

- Goal of the analysis is to look at the long-run impacts from GridWest
- Tool is Energy2020 integrated with PowerWorld
  - Energy2020 is a long-run energy market simulator integrating both supply side electric production costing with long-term technology choice and demand side load growth with end-use technology choice
  - PowerWorld is a transmission power flow model with OPF capable of determining both flows and marginal costs
- Contractor: Jeff Amlin, Systematic Solutions Inc., Fairborn, Ohio

ENERGY2020 Sector Relationships



Parameters for Decision Point 2

- **POTENTIAL BENEFITS TO BE MEASURED BY ANALYSIS:**
  - GW flow based AFC calculation/sales & reconfiguration auction.
  - CCA balancing markets (inc/dec markets facilitating economic redispatch)
  - Relief of pancaking.
- **BENEFITS NOT MEASURED:**
  - Benefits derived from more efficient operating reserve markets.
  - Economic dispatch for regulation/load following
  - Long Term siting/efficiency benefits.
- **TIME HORIZON OF ANALYSIS:**
  - 5 Years (beginning in ’08).

Parameters for Decision Point 2

BASELINE ANALYSIS

- **Energy 2020 estimates loads, determines resource requirements/additions, schedule and prices for native load, bilateral and day-ahead/real-time market segments**.
  - Energy demand growth determined by GlobalInsight Economic Forecast
  - Fuel prices are from NW Power Council 5-Year Plan and normal water
  - Agents saddled with current resource/sunk costs & obligations
  - Existing transmission pricing and transmission path limits constrain the bilateral contracts Imperfect information
- **PowerWorld serves the role of control area operator**
  - Nominal conditions (all key lines and equipment in service)
  - Uses similar transmission tariffs and path limits as in Energy2020 to solve dispatch equation
  - Solves power flow ensuring feasible dispatch (CAISO super area represented)
  - Generates zonal and control area price signals based on generation bids submitted by Energy2020

Parameters for Decision Point 2

WITH GRID WEST ANALYSIS:

- **Energy 2020 estimates loads and resource schedules as in the Base Case**
  - All economic / fuel price conditions same as Base Case
  - GW Case uses same transport algorithm to limit scheduling.
  - Assume the relief of pancakes/hurdles (other than CA GMC)
  - Add transmission capability (0%, 3%, 5%, 10%) to reflect increased AFC derived from reconfiguration auction and single GW dispatch
- **PowerWorld translates to dispatch/transmission schedule:**
  - 3 consolidators redefined to 1 CA which economically redispatches
  - For remaining CAs plus new CCA, minimize change in interchange schedule, make scheduled dispatch technically feasible
  - Calculate cost of resulting dispatch

Market Simulation Process

- Energy 2020 generates native load/bilateral “proto schedules” using its market simulator.
  - Uses basic transport algorithm to limit scheduling.
  - Uses pancakes/hurdle rates, (include CA GMC)
- Power World converts proto-schedules to scheduled transactions
  - 2000 bus equivalenced WECC transmission model
  - Generate Schedule
- Calculate regional cost of resulting dispatch
- Energy 2020 then uses dispatch and known prices plus “forecast error” to generate day-ahead/real-time bids/schedules
- PowerWorld takes these bids plus bilateral scheduled transaction to calculate optimal dispatch and area level prices

Work To Date

Power World

- Problem with “failed” cases
  - Increase iterations before failure
  - Relocated slack bus
  - Data transfer
- Develop base line transmission tariffs
- Verify path limits
- Define Control Areas and align generation
- Established procedures to simulate multiple markets
  - PowerWorld acts as control area
  - Develop SuperAreas to determine bilateral schedules
  - Utilize control area representation to “optimize” dispatch and determine “market prices”

Work to Date

- Calibration of Energy 2020
  - Weather normal historical retail loads,
    - Energy demand driven by GlobalInsight Macroeconomic forecast
    - Checked for consistency with WECC forecasts and EIA regional forecast
  - Included historical state level energy consumption estimates by fuel and sector
  - Used publicly available embedded cost data
  - Used public generation data (SSG-WI assumptions for hydro generation)
  - Generation bid logic can be based on either variable cost or opportunity cost.